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Precision Cross-Calibration of the NMR calibration probes for the J-PARC Muon $g-2$ /EDM, J-PARC MuSEUM, and FNAL Muon $g-2$ experiments at the ANL 4T Magnet Facility

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The measurement of the muon anomalous magnetic moment a_μ is a precision test of the Standard Model and an indirect search for New Physics. The Muon $g-2$ (E989) collaboration has published the most precise measurement of the muon anomalous magnetic moment with an uncertainty of 460 ppb in 2021, leading to a world average that deviates by 4.2 standard deviations from the Standard Model prediction provided by the Muon $g-2$ Theory Initiative. The complementary Muon $g-2$ /EDM experiment (E34) at Japan Proton Accelerator Research Complex (J-PARC) is under construction.

Both experiments, as well as the Muonium Spectroscopy Experiment Using Microwave (MuSEUM), rely on the precision measurement of the magnetic field experienced by muons and muonium respectively. All three experiments use nuclear magnetic resonance (NMR) probes to measure of the magnetic field in terms of the precession frequency of the protons.

However, materials in the probes themselves perturb the local field resulting in small correction terms. In order to cross check these correction terms the different NMR probes that use different techniques, continuous wave (cw) versus pulsed NMR, are cross-calibrated in the Argonne National Laboratory (ANL) 4T Magnet Facility. The goal is to cross check the different probes on a 35 ppb level.

This poster gives an overview of the ANL 4T Magnet Facility, presents the status of the cross-calibration at 1.45T and 1.7T, and provides an outlook for calibrations at 3T.

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